

A First Response Crew Mask for Ammonia, Hydrazine and Combustion Products, Phase II

Completed Technology Project (2014 - 2016)



Project Introduction

The increasing frequency of International Space Station (ISS) egress operations contaminates the spacecraft environment with propellant residues (such as anhydrous hydrazine) and their decomposition by-products, as well as coolants such as ammonia and Freon. NH₃ and N₂H₄ have a 24 hour Spacecraft Maximum Allowable Concentration (SMAC) of 7 ppm and 0.3 ppm, respectively. TDA Research Inc. is developing a new adsorbent that can remove these contaminants to sub ppmv concentrations with high activity and capacity. The sorbent can be integrated as a thin layer into an existing cartridge used in the ISS first response crew mask; the new media will greatly extend the capability to protect against the NH₃ and hydrazine for extended duration under high contaminant challenges, without undermining the ability of the cartridge to filter out other combustion by-products. In Phase I, we successfully completed all proof-of-concept demonstrations at the bench-scale elevating the TRL to 3. The new adsorbent can provide over 1,400 minutes of protection when challenged with 50 ppmv NH₃ and over 450 hrs with 1 ppmv anhydrous N₂H₄, even at a bed aspect ratio as low as 0.1 and at gas-solid contact times as low as 0.11 sec. The NH₃ and N₂H₄ capacity of the sorbent exceeds 1.8% wt. and 1.4% wt., respectively, with bed outlet concentrations maintained at less than 40 ppbv. In Phase II, we will continue to optimize the sorbent formulations and scale-up the production. We will design and fabricate full-scale experimental prototype cartridges at TDA to support demonstrations in an environmental chamber using a breathing apparatus. Based on the results, we will design and fabricate high fidelity cartridges based on the flight qualified ISS Fire Recovery Respirator Cartridge and complete high fidelity demonstrations in an environmental chamber to fully demonstrate its capability (non-human testing at TRL 6). These will be provided to NASA for additional testing and demonstrations.



ISS Fire Recovery Respirator Cartridge

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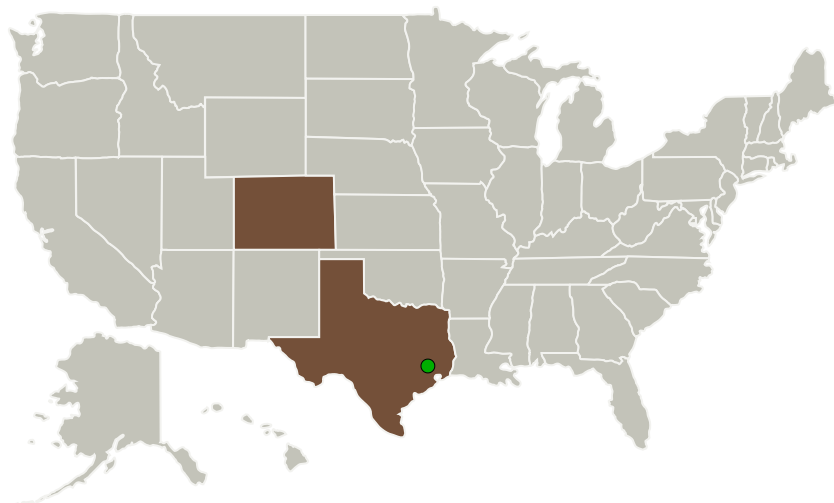
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
TDA Research, Inc.	Lead Organization	Industry	Wheat Ridge, Colorado
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations

Colorado	Texas
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Project Transitions

▶ **April 2014:** Project Start

✓ **October 2016:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/137580>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

TDA Research, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Gokhan Alptekin

Co-Investigator:

Gokhan O Alptekin

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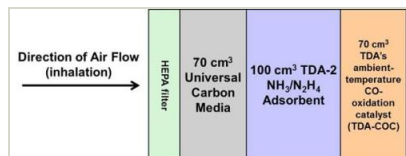
Images



ISS Fire Recovery Respirator Cartridge

Briefing Chart Image

A First Response Crew Mask for Ammonia, Hydrazine and Combustion Products, Phase II
(<https://techport.nasa.gov/image/130345>)

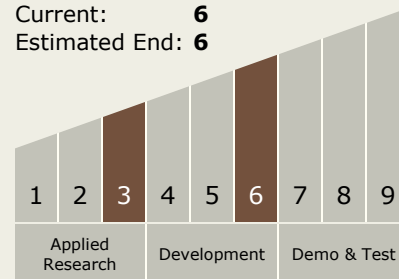


Final Summary Chart Image

A First Response Crew Mask for Ammonia, Hydrazine and Combustion Products, Phase II
Project Image
(<https://techport.nasa.gov/image/127659>)

Technology Maturity (TRL)

Start: 3
Current: 6
Estimated End: 6



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
 - TX06.4 Environmental Monitoring, Safety, and Emergency Response
 - TX06.4.3 Protective Clothing and Breathing

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System